
Impact of MACH Project Activities on Socio-economic and Environmental Conditions in Keuta Beel of Sherpur District

S.M. Abul Bashar

Abstract

The co-management approach is an effective tool for sustainable wetlands management. Through this approach, water bodies are operated and managed by local communities. The Management of Aquatic Ecosystems through Community Husbandry (MACH) and Integrated Protected Area Co-management (IPAC) projects have worked with various partners to improve dry season water management, establish fish sanctuaries, reduce fishing pressure by exploring alternative income-generating activities (AIGAs), promote policy-level coordination, link resource users, and carry out other activities with the overall goal of improving local wetland habitat. For this study, data collection was carried out through focus group discussions and semi-structured interviews. The results indicate that participation in co-management through AIGAs may contribute to certain socio-economic benefits, and that non-AIGA households who are heavily dependent on fish resources also benefitted from and supported co-management activities. I found that MACH and IPAC project activities have a positive impact on the socio-economic and environmental conditions of Keuta Beel and the surrounding area. In particular, the active engagement of fishers in co-management activities around Keuta Beel has helped to reduce fishing pressure, resulting in an overall increase in fish production in this region.

Introduction

Bangladesh is a nation of wetlands, rich in aquatic resources, particularly fish, which accounts for 58 percent of the animal protein consumed in the country (DoF 2011). Fish and fisheries play a momentous role in the economy of Bangladesh in the context of nutrition, employment, household income, and foreign currency earnings. Today, wetland environments and fish resources are threatened by the competing needs of a growing population and expanding agriculture and industry. It is a great challenge for the fisheries sector to continue to meet the increasing demand for

protein in this densely populated and growing country while facing these multiple threats.

Although small-scale fishers are central and indispensable constituents in the fisheries sector in Bangladesh, they often have difficulty earning a livelihood and face many economic pressures. The daily income of 27 percent of coastal fishers is less than 50 BDT (USD 0.59) (Ahmed 1999). In general, fishers are considered to be one of the most marginalized and vulnerable communities in Bangladesh because their socio-economic conditions are so poor (Paul 2003). They are burdened with food scarcity, insufficient drinking water access, insecure shelter, continuous debt, low healthcare access, poor sanitation, and illiteracy.

The wetland resources of Bangladesh must be wisely managed in order to maximize the sustainable production (harvesting) of fish, and to improve the socio-economic status of local fishers. Wise resource management should limit resource destruction and degradation and improve resource productivity. The Management of Aquatic Ecosystems through Community Husbandry (MACH) project was launched in several districts, including Sherpur District, in 2000, as a response to these socio-economic and environmental concerns. The project was designed and implemented by the Government of Bangladesh, with support from the United States Agency for International Development (USAID), and emphasized community-based participatory approaches to wetland management. The MACH project secured access rights to several key inland fisheries across Bangladesh and enlisted the help of local fishers and others to design and implement conservation schemes. The project worked with partners to improve dry season water management, establish sanctuaries, and reduce fishing pressure by promoting alternative income-generating activities (AIGAs), encouraging policy-level coordination, linking resource users and administrators, and improving local wetland habitats. The MACH project concluded in June 2008, leaving behind an endowment fund. The interest acquired from this fund can be used to support the activities of the *upazila* (local government unit) fisheries co-management committees in perpetuity.

Currently, management of protected areas in Bangladesh is being supported by the Integrated Protected Area Co-management (IPAC) program. IPAC began in 2008 with support from a variety of international organizations, including USAID, the East-West Center, the WorldFish, and the World Wildlife Fund. The program's main goal is to scale up collaborative management of natural resources in both policy and practice.

Wetland areas in Bangladesh consist largely of rivers, *haors* (large areas in the floodplains of major rivers typically inundated during the wet monsoon season), and *beels* (smaller low-lying perennial water bodies in depressions that are usually connected to larger haor systems during monsoon). The fishers of Keuta Beel in Sherpur Sadar (*sadar* is a small unit of local government) continue to support the goals of the MACH project through ongoing co-management activities. Different development and management programs and measures have been executed in the beel, such as the establishment of fish sanctuaries, the stocking of fingerlings, the rehabilitation of endangered species, and the implementation of fish policies and legislation. The aim of this study is to examine any changes in social and economic conditions that have occurred in Keuta Beel due to IPAC and MACH activities. I will determine if the fishers experienced benefits from co-management activities around the beel and what those benefits have included. More precisely, the objectives of this study are:

- To assess and compare the economic status of fishers who have received AIGAs with that of those who have not, on the basis of income, fish consumption, and employment patterns.
- To assess and compare the social status of fishers who have received AIGAs with that of those who have not, on the basis of food, shelter, education, healthcare, and sanitation facilities.
- To determine the impact of AIGAs and other co-management activities on fish production (harvesting) in the beel.
- To make recommendations for more effective management and use of the area's wetland resources.

Background


Sherpur District is located in north-central Bangladesh. Geographically, the area is part of the Garo and Tura Hills, and includes the catchment areas of the upper Kangsha and Malijee watersheds. This district contains many water bodies, such as beels, canals, rivers, and *jharna* (narrow hill streams that flow from upstream rivers). Most of the people in the district are poor, with limited employment opportunities. A large number of them, particularly those who reside in villages near water bodies, fish for subsistence and/or commercial purposes.

Keuta Beel is situated in Sherpur Sadar Upazila about 10 kilometers east of Sherpur town (see Figure 1) and is one of the more established and successful co-management sites supported by the MACH and IPAC projects. The beel covers an area of 40 hectares and is surrounded by five villages in three unions. There are both resource management organizations (RMOs) and federations of resource user groups (FRUGs) operating in the beel. The IPAC project has also identified this site as an important protected area (IPAC 2008). The Keuta Beel FRUG consists of 27 groups with 567 members (mostly poor and landless people), 39 percent of whom are women. Different types of professionals are involved in the group. Members are directly involved in co-management activities and are provided with training, small loans, and resources for AIGAs.



Figure 1: Map of the study area (Source: LGED)

For many years, the natural productivity and biodiversity of the beel has been declining due to irrigation systems in the area (both because of the diversion of water from the beel and the presence of agricultural pollutants) and intense fishing pressure (Shajahan 2011). The beel has also been threatened by siltation and soil erosion caused by farming practices in the surrounding area (Shajahan 2011). As a result of these pressures, the lives of poor villagers and local residents who depend on fish and aquatic plants for income and food have grown increasingly desperate. To address this problem, members of the FRUG and other fishers who live near the beel have set up small fish sanctuaries, planted trees, stocked threatened fishes, stopped harmful fishing practices such as poisoning or draining ponds to catch fish, and overseen



fishing bans when fish are spawning. As a result, fish catches have grown throughout the beel and small fish, birds, and plants are also increasingly found there. The majority of households in the surrounding villages are still engaged in fishing, although for those households that formerly relied primarily on fishing it is becoming a part-time and/or seasonal occupation. Traditionally, residents in these villages have caught fish throughout the year and sold them to intermediaries on the riverbanks, or taken them to nearby markets themselves. In this study, I look at changes that have occurred as a result of the implementation of the MACH and IPAC projects.

The MACH project was launched in Keuta Beel in 2000. In 2001, it provided loans to fisher/day laborer households who met certain criteria they had to be fully dependent on the beel resources for their income, have less than 40.46 square meters of land, have a monthly income of less than 3,000 BDT, and have poor housing conditions. The MACH/IPAC projects not only have provided AIGAs to fishers, but have also established a co-management program and institutions, and an endowment fund (of 250,000 BDT) so that all of the fishers can benefit from these resources either directly or indirectly.

Methods

This study relies on both primary and secondary data. I gathered secondary data by consulting relevant published and unpublished MACH documents, as well as related reports from the Department of Fisheries (DoF), the Department of Agriculture Extension (DAE), the Department of Environment (DoE), and other relevant organizations.

I collected primary data from fishers through a household survey, using an open-ended questionnaire. Fieldwork was conducted over a period of six months, from August 2011 to January 2012. An open-ended survey instrument was prepared, tested, and revised before going to the field for final data collection. To ensure data accuracy and objectivity, the interview questionnaire was kept simple and relevant to the main research objectives and the selected fishers were interviewed separately. Questions were asked systematically and explanations were given whenever necessary. All respondents were interviewed, regardless of their membership in a FRUG.

In total, I interviewed 20 households: 10 in a co-management village receiving funds through AIGAs; and 10 in a village that was not under co-management and did not

receive support for AIGAs. The sampling was done randomly. I chose to collect data in two of the five villages located in the immediate area, namely Bakarkanda, a co-management village situated in Dhala Union and receiving AIGA support; and Barogoria, a non-co-management village situated in Kamaria Union of Sherpur Sadar Upazila and not receiving AIGA support. The main criteria for choosing these villages were:

1. They are predominately surrounded by the beel area and villagers have easy access to it.
2. The fishers living in both villages are direct beneficiaries of Keuta Beel.
3. These fishers have been fishing in Keuta Beel for more than five years.

I also conducted five secondary interviews and one informal group discussion with other local community members who did not receive AIGA support, but nonetheless benefitted from the beel, to cross-check responses and to get a clearer picture of the views of local people and how they could use the wetlands more effectively.

Results and Discussion

In this section, I first describe the changes in the economic and social conditions of fishers using standard economic indicators (income, savings, and economic opportunities) and some common measurements of basic needs, comparing those who received support for AIGAs with those who did not. Next, I look at the impact on fish production in terms of trends that have occurred due to the co-management of wetlands. I also look at the specific benefits that fishers have received from co-management activities around the beel, including AIGAs. All respondents were direct resource users. Of the 20 respondents from the two villages, the age class with the most respondents was 35–45 years old (45%), followed by 55 years old and older (25%), 46–55 years (20%), and finally, 34 years old and younger (10%).

Assessment and Comparison of Economic Aspects

In this section, I compare AIGA and non-AIGA households according to key economic indicators, including annual income levels, savings, monthly fish consumption, and employment patterns (i.e. occupation).

Fishing is the major, and in some cases only, source of income for fishers in the Keuta Beel area. However, many individuals undertake a variety of additional economic activities, which can constitute a substantial part of their annual income. Fishers have limited options for non-fishing activities, such as wage labor in other sectors like

agriculture, construction, and cattle and poultry farming. My research reveals that the highest annual income among AIGA households was 120,000 BDT, while the lowest income was 38,000 BDT. According to my analysis, the number of AIGA households in each range of average monthly income is as follows: one household (10%) for “Up to 44,000 BDT”; no households for “45,000–54,000 BDT”; three households (30%) for “55,000–65,000 BDT”; and six households (60%) for “Above 65,000 BDT.” On the other hand, the highest annual income among non-AIGA households was 84,000 BDT and the lowest was 26,000 BDT. According to my analysis, the number of non-AIGA households in each range of average monthly income is as follows: three households (30%) for “Up to 44,000 BDT”; four households (40%) for “45,000–54,000 BDT”; two households (20%) for “55,000–65,000 BDT”; and one household (10%) for “Above 65,000 BDT” (Figure 2). These results are shown in Figure 2.

Despite their high reliance on fishing for their livelihoods, the income of non-AIGA fishers has decreased over the years due to the involvement of more people from neighboring communities in fishing as a seasonal or part-time occupation.

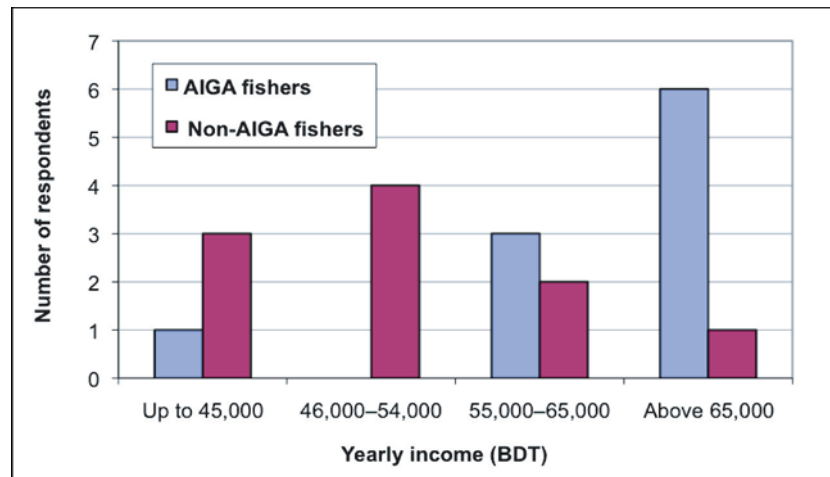


Figure 2: Yearly income of AIGA vs. non-AIGA fisher households (BDT)

The ownership of fishing and non-fishing assets among respondents is limited in general, but AIGA households have been able to develop their assets through technical and financial support from cooperatives and other organizational activities and projects. According to my analysis, the yearly savings of AIGA households varies from 5,000 BDT to 18,000 BDT. Out of 10 AIGA households, one household (10%)

was found to have no savings, two households (20%) had savings of up to 5,000 BDT, three households (30%) had savings of 5,000–10,000 BDT, and four households (40%) had savings above 10,000 BDT. In contrast, among the non-AIGA households, I found that nine households (90%) had no savings and the remaining one household (10%) had savings of above 10,000 BDT (Figure 3).

These findings suggest that AIGA households were able to save more money from fishing, as well as through other income generating activities. This has enabled them to invest their money in the trading of fish, agriculture, and others business ventures during the off-season. The main constraints to improving fishers' living standards are the lack of inputs and the debt incurred through the traditional credit system, which binds them to their communities and their occupation (Ruddle 1994).

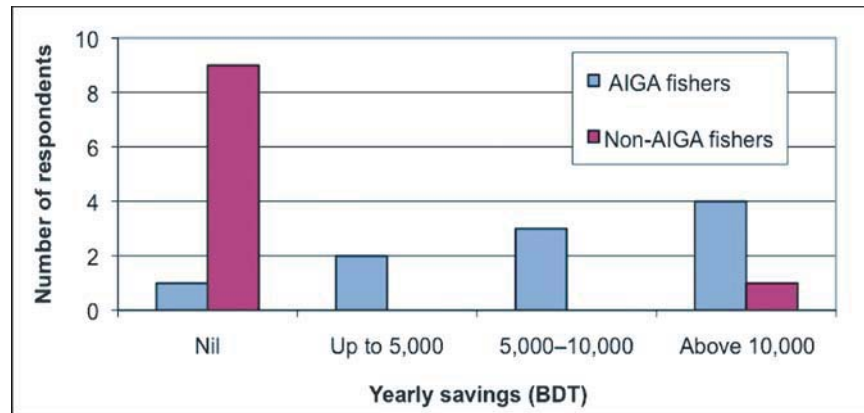


Figure 3: Yearly savings for AIGA vs. non-AIGA fisher households (BDT)

From the interviews, I learned that, among AIGA-receiving fishers, monthly fish consumption varied from 4.6 to 12.8 kilograms. According to my analysis, the average monthly fish consumption of AIGA households is as follows: “Up to 5 kilograms” for one respondent (10%); “5–10 kilograms” for three respondents (30%); and “Above 10 kilograms” for six respondents (60%). On the other hand, among non-AIGA fishers the lowest fish consumption was 3.6 kilograms and the highest was 11.2 kilograms. Two non-AIGA households reported their fish consumption was “Up to 5 kilograms,” seven households (70%) said their consumption was “5–10 kilograms,” and one household (10%) reported their consumption was “Above 10 kilograms.” Thus, overall, it is evident that AIGA households have higher fish consumption than non-AIGA households (Figure 4).

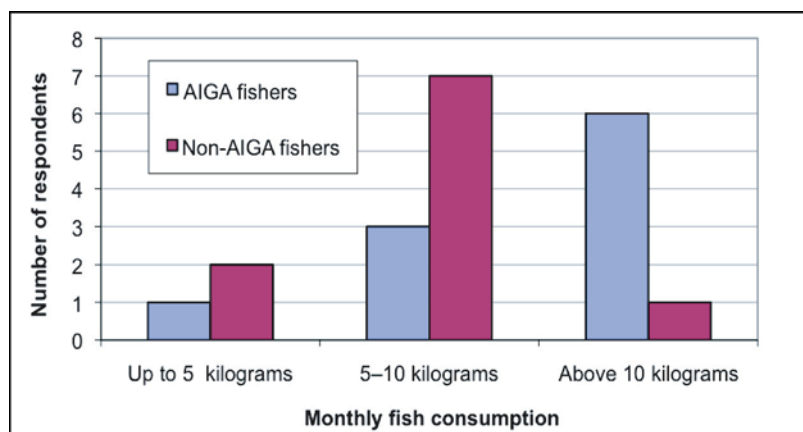


Figure 4: Monthly fish consumption of AIGA vs. non-AIGA fisher households

Through my survey, I identified the employment patterns and sources of income of AIGA fishers and non-AIGA fishers. My analysis revealed that, of the 10 AIGA households, 10 (100%) were engaged in fishing, one (10%) in agricultural labor, two (20%) in pulling rickshaw-vans, four (40%) in cattle/poultry rearing, two (20%) in handicraft/petty trade, and one (10%) in other activities. Among the non-AIGA households, 10 (100%) engaged in fishing, six (60%) in agricultural labor, one (10%) in pulling rickshaw-vans, and one (10%) in cattle/poultry rearing (see Table 1).

These results demonstrate that fishers who have participated in the MACH and IPAC projects are engaged in other occupations apart from fishing. AIGA fishers receive financial and technical support from the MACH and IPAC projects, as well as from other organizations. However, non-AIGA fishers often lack assets, savings, training, and other financial inputs for income-producing activities unrelated to fishing.

Table 1: Income sources of AIGA vs. non-AIGA fisher households

Income Source	AIGA Fishers	Non-AIGA Fishers
	Number (and %) of respondents	Number (and %) of respondents
Fishing	10 (100)	10 (100)
Agricultural labor	1 (10)	6 (60)
Non-agricultural labor	--	--
Rickshaw-van	2 (20)	1 (10)
Handicraft/petty trade	4 (40)	1 (10)
Cattle/poultry rearing	4 (40)	1 (10)
Business	2 (20)	--
Other	1 (10)	--

NOTE: Due to multiple responses, percentages do not add up to 100 percent.

Assessment and Comparison of Social Aspects

Local fishers who received AIGAs in the MACH and IPAC projects have more financial and technical support to acquire knowledge, experience, and assets that could transform their socio-economic status. As demonstrated by the above results, they also have higher income and savings, and more diversified employment opportunities, which could also enhance their social status. Here, I compare the educational status of respondents' children, household food intake, housing construction materials, birthplace of respondents' children (e.g. home, hospital), and household sanitation facilities, to see if there is any significant difference between the status of AIGA and non-AIGA households.

Educational status differs between children of respondents receiving AIGAs and those not receiving AIGAs. Among the children of AIGA recipients, about 10 children (56%) had completed primary level education and six children (33%) had completed secondary level education, while only two children (11%) had dropped out of school before completing their primary education. Conversely, among the children of those households not receiving AIGA support, I found that about 11 (42%) had received a primary education, four (15%) had received a secondary education, eight (31%) had dropped out of school before completing their primary education, and the remaining three (12%) were below the age of five (Figure 5). At the time of the survey, none of the children had completed an education above the secondary level.

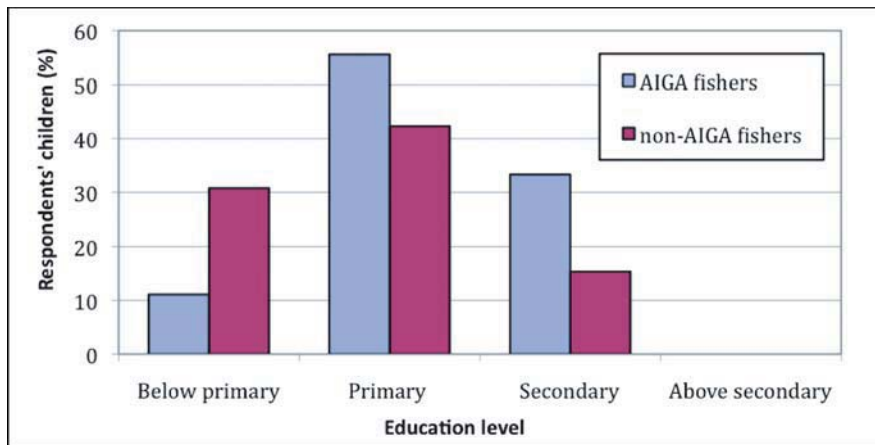



Figure 5: Educational status of respondents' children



The most striking difference between the educational status of children from AIGA households and non-AIGA households is that 31 percent of the children from the non-AIGA households dropped out of school before completing their primary education, compared to only 11 percent of children from AIGA households. Bishwajit (2011) found that, near Baikka Beel in Moulvibazar district, 30 percent of the children from non-MACH households and six percent of the children from MACH households dropped out of school before completing their primary education. This is consistent with my findings. This study reveals that most households receiving AIGAs, as well as a smaller proportion of non-AIGA households, want their children to receive an education so that they can obtain good employment and thus improve their social status. However, according to my survey responses, many non-AIGA households pull their children out of school, perhaps to fish or perform other work to help support the family. Overall, more children from AIGA households have gone to primary school and completed a secondary-level education, and fewer have dropped out of primary level. This may be related to increases in monthly income and savings that could be a result of involvement in AIGAs and co-management activities.

Food intake, in terms of the frequency of meals and consumption of various food items, also differed between households of fishers receiving and those not receiving AIGAs. Out of the 10 households receiving AIGAs, I found that one (10%) ate two meals per day and nine (90%) ate three meals per day. Furthermore, 10 (100%) of the AIGA households consume fish, seven (70%) consume lentils, and six (60%) consume vegetables on a daily basis, while three (30%) consumed meat on a weekly basis. On the other hand, among the 10 non-AIGA households, I found that four (40%) take meals twice a day and six (60%) take meals thrice a day. Furthermore, among non-AIGA households, seven (70%) consume fish, two (20%) consume lentils, and two (20%) consume vegetables on a daily basis, while no households consume meat on a weekly basis (Figure 6).

Based on a study of the socio-economic conditions of fishing communities in Bangladesh, Hannan (1994) states that fishers are a highly neglected class in society and many are living hand-to-mouth. My results support this assertion, and suggest that households receiving loans for AIGAs are better off, since significantly more of the non-AIGA households cannot afford three meals a day for their families, don't eat meat on a regular basis, and consume less protein in the form of fish and lentils.

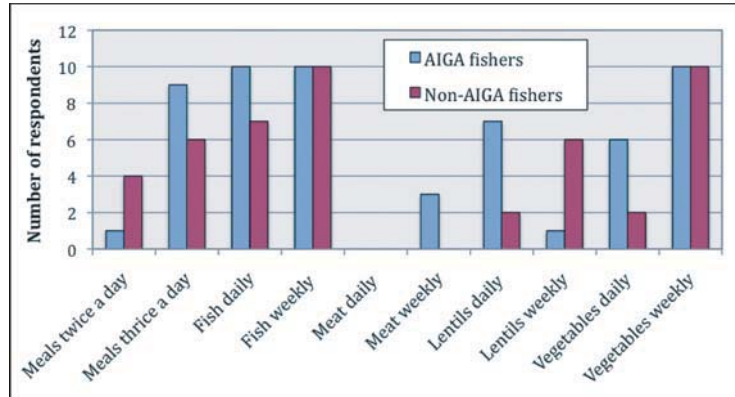


Figure 6: Type and frequency of foods consumed by AIGA vs. non-AIGA households

Since soil is an abundant and inexpensive resource, and concrete is rare, the majority of houses in the villages are not made of concrete. They are constructed adjacent to one another and are made of tin (steel sheet), bamboo, and/or earth, with soil floors. Both the roof and the walls are typically made of tin. According to my survey among the AIGA households, 10 of their houses (100%) have roofs and walls made of tin and 8 houses (80%) have floors made of soil, while the remaining two houses (20%) have floors made of concrete. In contrast, out of the 10 non-AIGA households, 10 houses (100%) have roofs made of tin; 9 houses (90%) have floors made of concrete and one has soil floors; and the walls are made of tin (five households, 50%), bamboo (four households, 40%), or soil (one household, 10%) (see Figure 7). In other words, AIGA households have more durable housing facilities. This could be due to the fact that they have earned more income and savings from AIGA activities implemented as part of co-management.

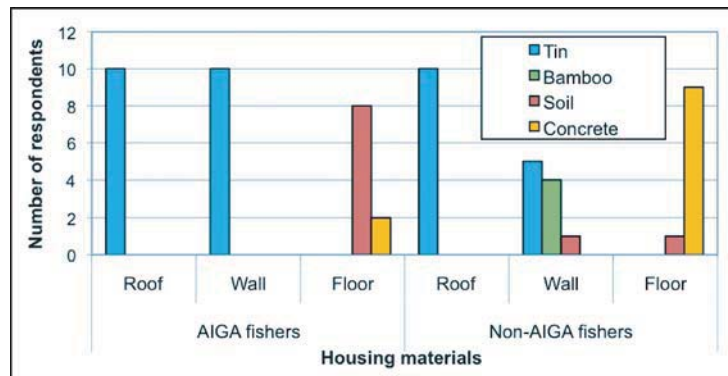


Figure 7: Housing conditions of AIGA vs. non-AIGA fisher households

Groundwater, which is obtained via tube wells, is the only source of drinking water in the village. But there has been an alarming fall in groundwater levels due to its excessive use for irrigation purposes. Most tube wells have no concrete platforms and their general cleanliness is not good. For both the AIGA and non-AIGA households, I found that 100 percent have access to tube wells.

In order to understand the health issues in the villages, it is important to see how the health system operates in the country and how it filters down to the community level. The discussion that follows considers the health-related issues in Sherpur District, Sherpur Sadar Upazila, and the study villages. In my study area, there is no health clinic and, as a result, villagers face severe health problems. The nearest health center is at Sherpur, about seven kilometers away, but there is no efficient means of transportation (i.e. the roads are poor) from the villages to Sherpur. As part of this study, I analyzed the birthplace of the households' children according to the following categories: (1) hospital, (2) clinic, (3) home, and (4) other. Among the AIGA households, three (30%) of their children were born in a hospital and seven (70%) were born at home. However, all (100%) of the children from non-AIGA households were born at home (Figure 8). Thus, according to my survey results, AIGA fishers are more conscious about reproductive health in terms of where they choose to have their children. This could be due to their enhanced income and savings as a result of participation in AIGAs in particular, and in co-management activities in general.

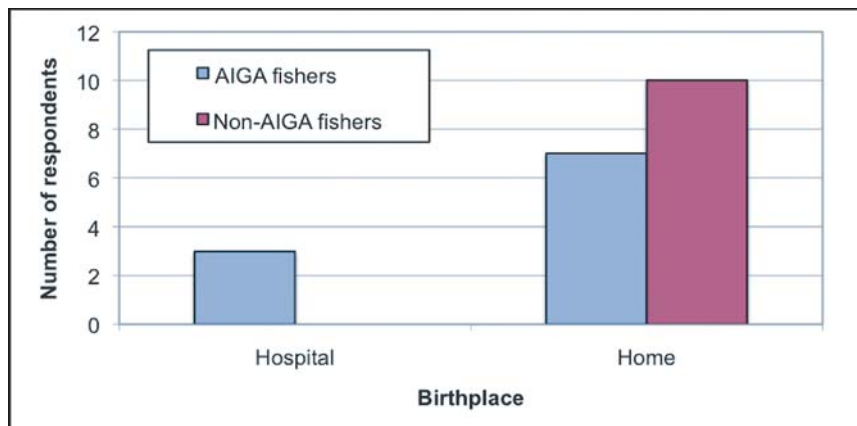
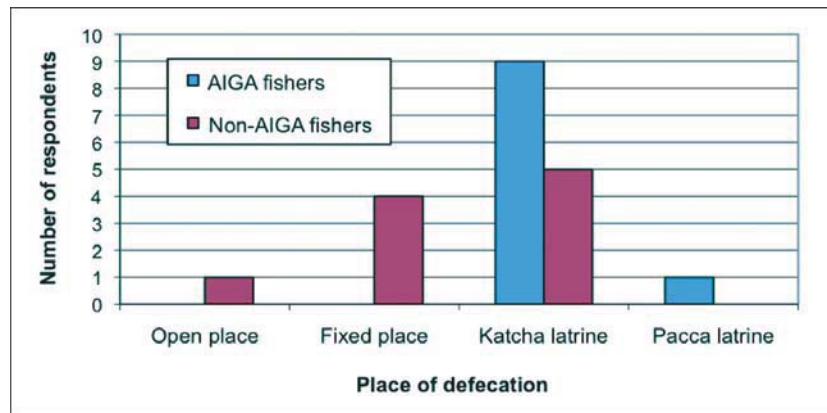


Figure 8: Birthplace of children for AIGA vs. non-AIGA fisher households

There is no suitable place for defecation among some of the households in the village. As part of this study, I analyzed the households' place of defecation according to the following categories: (1) open place (no fixed toilet); (2) fixed place; (3) *katcha* latrine (temporary toilet made of packed earth); and (4) *pacca* latrine (wet latrine made of bricks and concrete). Among the AIGA households, nine (90%) used *katcha*

latrines, while one (10%) used a pacca latrine and none used an open or fixed place. Among the non-AIGA households, one (10%) used an open place, four (40%) used a fixed place, and five (50%) used a katcha latrine, while none used a pacca latrine (Figure 9). According to my survey results, AIGA households had better sanitation facilities overall. Again, this could be because they have earned more income through their involvement in AIGAs and co-management.



Respondents' Views about Benefits from Co-management Activities

I gathered different types of data to identify the benefits experienced from co-management activities. Among the AIGA households, 10 (100%) mentioned an increase in fish production, participation in training programs, involvement in other economic activities besides fishing, and knowledge about the maintenance and guarding of the fish sanctuary as benefits; nine (90%) mentioned participation in decision-making meetings, knowledge about the Fish Act and laws, and knowledge about which gear is more/less destructive; and eight (80%) mentioned involvement in environmental protection activities and knowledge about the ban season for harvesting. On the other hand, of the 10 non-AIGA households, nine (90%) noticed increased fish production, four (40%) knew about maintenance and guarding of the fish sanctuary, two (20%) mentioned participation in decision-making meetings, involvement in environmental protection, involvement in activities other than fishing, knowledge about the ban season for fish harvesting, and knowledge about which gear is more/less destructive; and one respondent (10%) mentioned involvement in training programs and knowledge of the Fish Act and laws. Overall, I found that the AIGA fisher households reported more benefits, suggesting a stronger positive influence on their participation, knowledge, and awareness about co-management activities and involvement in AIGAs (See Table 2).

Table 2: Respondents' views about benefits received from co-management activities

Benefits	AIGA fishers (n = 10) Number of respondents (%)	Non-AIGA fishers (n = 10) Number of respondents (%)
Increased fish production	10 (100)	9 (90)
Receiving training	10 (100)	1 (10)
Participation in decision-making meetings	9 (90)	2 (20)
Involvement in environmental protection	8 (80)	2 (20)
Involvement in activities other than fishing	10 (100)	2 (20)
Knowledge about maintenance and guarding of the fish sanctuary	10 (100)	4 (40)
Knowledge about ban season for fish harvesting	8 (80)	2 (20)
Knowledge about the Fish Act and laws	9 (90)	1 (10)
Knowledge about which gear is more or less destructive	9 (90)	2 (20)

Impact of Activities on Fish Production in Keuta Beel

I found that due to the MACH and IPAC project activities, the average fish production is increasing and the number of fishers is decreasing. The analysis revealed that the AIGA households said their average fish production was 1.05 metric tons per hectare in 2008, 1.08 metric tons per hectare in 2009, and 1.22 metric tons per hectare in 2010. On the other hand, non-AIGA households reported that during these same years their average fish production was 1.08 metric tons per hectare, 1.17 metric tons per hectare, and 1.29 metric tons per hectare, respectively (Figure 10).

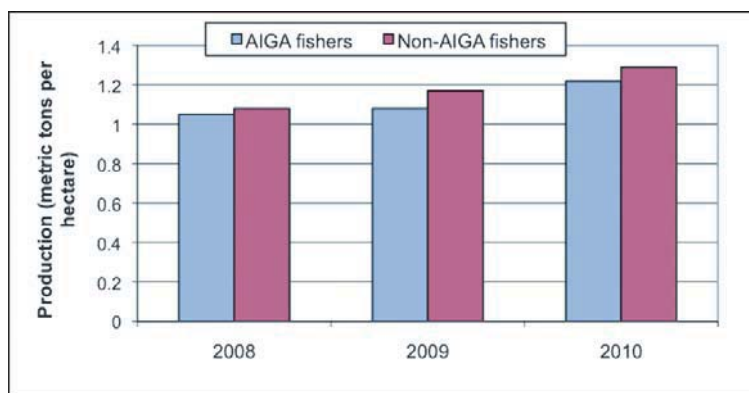


Figure 10: Average fish production (in metric tons per hectares) from 2008 to 2010

In terms of engagement in fishing, the average number of people involved in fishing in Keuta Beel in 2008, 2009, and 2010, as reported by the 10 households receiving AIGAs, was 283, 262, and 242, respectively. On the other hand, the average number of people engaged in fishing that was reported by the 10 non-AIGA households was 319, 306, and 297 during these same years (Figure 11).

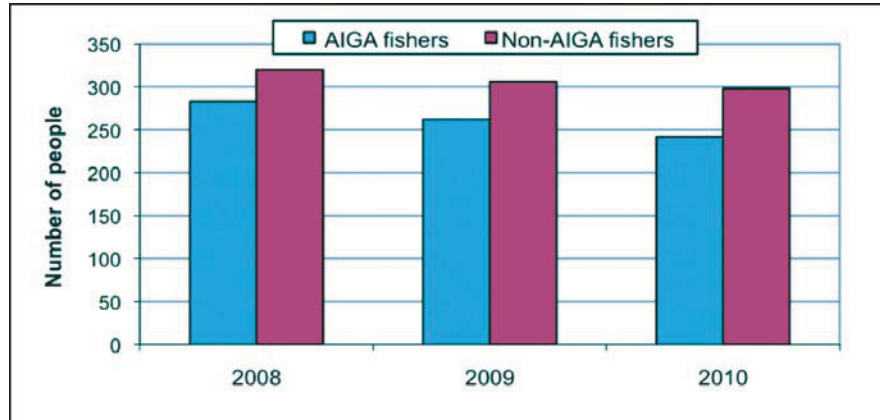



Figure 11: Number of people engaged in fishing in the last three years

While environmental degradation (caused by late rains, heavy siltation, and agricultural pollution) has occurred, the beel area is also shrinking and becoming crowded with aquatic weeds. At the same time, some fishers are facing unemployment and some have migrated to urban areas for work, either temporarily or permanently. Along with these trends, the overall fish production has increased and the total number of people engaged in fishing has decreased for both groups during implementation of the MACH and IPAC projects. This implies that fewer fishers (both AIGA and non-AIGA) are catching more fish and potentially earning more income from fishing, in addition to their non-fishing activities. The socio-economic results from this study provide some evidence for this.

During the project interventions, the quality of life of AIGA households has improved significantly. Thus, it could be concluded that participation in co-management at Keuta Beel through involvement in AIGAs may have improved certain socio-economic aspects of AIGA households such as food (diet), education, housing facilities, healthcare, income, fish consumption, and employment opportunities. However, the concurrent benefits to non-AIGA households suggest that co-management activities have also had indirect benefits for non-participating fishers



who are heavily dependent on Keuta Beel. Although not all fishers received AIGAs, many have been involved in fish sanctuary maintenance, including sanctuary excavation and re-excavation, and other types of co-management activities. They have supported these efforts because they receive indirect benefits from them. As a result, all of the fishers, including both AIGA and non-AIGA households, replied that active engagement of fishers in co-management activities has helped to reduce fishing pressure, resulting in an overall increase in fish production. The objectives of the AIGAs were to: (1) improve livelihoods, (2) reduced dependence on fishing, and (3) increase other economic opportunities. My findings reveal that current trends among AIGA households are consistent with these objectives.

Conclusions and Recommendations

Findings from this study suggest that the MACH and IPAC projects may have had a positive impact on both the socio-economic and environmental conditions of Keuta Beel and the surrounding area. These initiatives have actively engaged fishers in co-management activities and have made a contribution to reducing pressure on the fishery as a result of the overall increase in fish production (harvesting). Co-management helps to ensure more active participation of community group members and, therefore, more inclusive decision-making during meetings. Based on the findings of this study, I strongly believe that the active involvement of user groups in co-management activities can improve their socio-economic conditions.

Community members' responses concerning their involvement in and benefits from the MACH and IPAC project activities are encouraging, because they suggest that the livelihoods of fishers have improved as a result of initiatives jointly supported by the government of Bangladesh, NGOs, the upazila administration, local agencies, and the efforts of community members themselves. Based on the data I have presented in this paper, I conclude that the fisher households that have participated in MACH and IPAC are doing better than non-MACH and IPAC fishers in terms of basic economic indicators (overall income, savings, consumption, employment, and involvement in alternative income-generating activities during the off-season) and social indicators (education, food, housing, healthcare, and sanitation). Moreover, fishers can benefit from training and technical support provided by different government programs and non-governmental organizations.

IPAC is now working in Keuta Beel, but many fishers are not yet aware of this. Therefore, I suggest several additional measures to make the current and future

project interventions more effective:

- Establish community-managed water bodies where only local fishers are allowed to catch fish.
- Promote wider participation in FRUGs, since only a small percentage of households are currently involved in them.
- Increase the scope and amount of loans for AIGAs, since the financial benefits of AIGAs have been limited and insufficient.
- Provide capacity-building training for all fishers, including those not participating in AIGAs.
- Conduct an awareness-raising program so that all RUG members are informed of government policies and legislation.
- Increase the number of fish sanctuaries.
- Provide suggestions to fishers on how they can work together to fulfill their shared responsibilities and duties in order to enhance accountability and transparency in every aspect of co-management.
- Construct and maintain a community center in the beel area so that decision-making meetings will run properly, and as a repository for relevant documents and materials.

This study suggests that the government and NGOs can take further initiatives to enhance co-management for the betterment of fishers' livelihood security and financial means. In particular, the Land Ministry of Bangladesh should take immediate measures to designate and demarcate the beel area for protection; otherwise this resource could be captured by elites, which would create further obstacles to implementing the co-management approach. This research provides important lessons for wetland conservation and natural resources management and can help enhance planning and awareness among policymakers, government agencies, NGOs, and communities involved in co-management.

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